REPRESENTING LOW-INCOME HOUSEHOLDS IN BUILDING ENERGY MODELLING TOOLS

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In urban areas, low-income households experience a high energy burden and need to allocate a disproportionate share of their income to energy expenditures due to energy inefficiencies in their homes. Thus, in the recent years researchers and policy makers have been focused on improving the low-income housing stock. However, all parties involved in this process suffer from a lack of reliable data that is specific to low-income households and their unique characteristics. For instance, while building energy performance modelling tools can reveal valuable information and provide a basis for informative decision making, most of such tools need occupancy related data to count for the effect of presence and activities of users on energy consumption. This need for reliable occupancy data becomes challenging when little to no data is available for representing unique populations like low-income households. Accordingly, in this study we used clustered population-specific data collected via a mail survey to refine the results of a two-state stochastic occupancy prediction model based on the 2018 American Time-Use Survey (ATUS). These refined results can be used to represent users' energy-related behaviors in any conventional building energy modelling tool which would then be able to produce reliable energy consumption profiles and predict the impact of different energy efficiency upgrades. Such predictions can in turn be used to provide socially contextualized feedback on current and future energy consumption. An early application study of our schedules, shows a mean of 2% reduction in energy consumption when compared to the use of a static standard occupancy schedule (ASHRAE 90.1). This 2% difference translates into a 3.5 kwh/m^2 gap between the two modeling approaches and therefore, the small but crucial adjustment of developing representative schedules has been a big step towards bridging the gap between simulation results and actual energy use of the studied residential buildings.

Keywords: Occupant behavior, American Time-Use Survey, Markov-Chain